

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
3 May 2001 (03.05.2001)

PCT

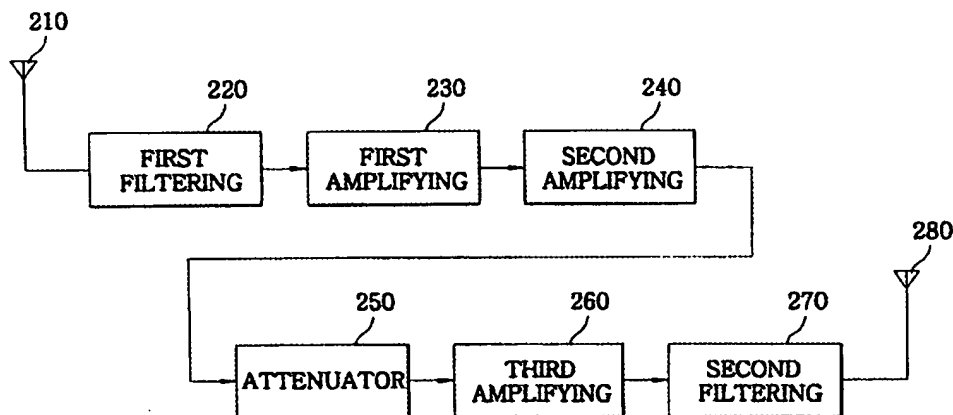
(10) International Publication Number
WO 01/31804 A1

- (51) International Patent Classification⁷: **H04B 1/59** Sun [KR/KR]; Sejong Apt. 646-1404, Sanbon-Dong, Kunpo-Si, Kyunggi-Do 435-040 (KR). SIM, Seon, Ho [KR/KR]; Goonjeon Apt. 806, Sinwol-Dong, Yangcheon-Ku, Seoul 158-090 (KR). KANG, Joong, Kil [KR/KR]; New Seoul Apt. 105-704, Songnae 1-Dong, Sosa-Ku, Bucheon-Si, Kyunggi-Do 422-041 (KR). LEE, Soo, Young [KR/KR]; Hanyang Apt. 3-806, 757, Sangkye-Dong, Nowon-Ku, Seoul 139-200 (KR).
- (21) International Application Number: PCT/KR00/01203
- (22) International Filing Date: 24 October 2000 (24.10.2000)
- (25) Filing Language: Korean
- (26) Publication Language: English
- (30) Priority Data:
1999/46255 25 October 1999 (25.10.1999) KR
- (71) Applicant (for all designated States except US): SK TELECOM CO., LTD. [KR/KR]; 99, Seorin-dong, Chongro-ku, Seoul 110-110 (KR).
- (74) Agent: JANG, Seong, Ku; KEC Building, 17th floor, 275-7, Yangjae-Dong, Seocho-Ku, Seoul 137-130 (KR).
- (81) Designated States (national): AU, CN, JP, US.
- Published:
— With international search report.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

- (72) Inventors; and
(75) Inventors/Applicants (for US only): KIM, Jong,

(54) Title: APPARATUS FOR RELAYING A TRANSMISSION SIGNAL



(57) Abstract: An apparatus relays a signal transmitted from a specified base station to a mobile station in CDMA wireless telecommunications systems. To this purpose, the apparatus, installed in an area where signals transmitted from a plurality of base stations co-exist or a soft blocking occurs, operates by following the steps of receiving the signal transmitted from a specified base station having smaller number of calls than the other neighboring base stations, filtering a signal within a service frequency band from the received signal, amplifying the filtered signal, adjusting a gain of the amplified signal and finally transmitting the gain-adjusted signal to the mobile station. Accordingly, a pilot pollution phenomenon is removed and an effective call distribution is achieved, so that the efficiency in using system resources can be greatly improved.

WO 01/31804 A1

APPARATUS FOR RELAYING A TRANSMISSION SIGNAL

FIELD OF THE INVENTION

5 The present invention relates to a mobile telecommunications system; and, more particularly, to an apparatus for amplifying a signal transmitted from a specified base station and relaying thus amplified signal to a mobile station.

BACKGROUND OF THE INVENTION

10

 In CDMA (code division multiple access) mobile telecommunications systems such as personal communications systems, wireless data communications networks, next generation telecommunications systems (IMT-2000), and the like, transmission of signals is performed by using a same frequency at an identical time. Each of the signals, however, uses a different
15 pilot number, thereby having orthogonality. Therefore, a receiving end needs to know the pilot number and should be synchronized before receiving the signal.

 In the CDMA telecommunications system, a mobile station (MS) requests an establishment of a call to a base station (BS) transmitting the strongest signal among a plurality of base stations nearby.

20

 As shown in Fig.1, in a downtown area or in a place where base stations are densely located, a pilot pollution phenomenon, in which signals transmitted from a plurality of base stations co-exist, or an excessive handoff (e.g. 3-way or beyond), in which a single mobile station is simultaneously connected to a multiplicity of base stations, may occur.

 As illustrated in Fig. 1, if a mobile station (160) is located in an area covered by four
25 different base stations, the above-stated pilot pollution phenomenon or excessive handoff occurs, and thus a first to a fourth base stations (110 to 140) all allocate their resources to the mobile station 160, so that the efficiency in using system resources is deteriorated.

 To be more specific, a signal-to-noise ratio (SNR) must be sustained above a certain level in order to guarantee the quality of signals and communications in the mobile station.
30 However, in the pilot pollution area where the signals transmitted from the plurality of base stations co-exist, since a receiving end (a forward link) of the mobile station recognizes as noises signals transmitted from base stations other than the one the mobile station is currently connected to, the signal-to-noise ratio of the mobile station gets relatively lowered, so that the quality of signals and communications is impaired, resulting in a communications disorder.

35 Furthermore, in order to improve the quality of signals and communications, the

mobile station transmits its signals with an increased transmission (TX) power, which in turn shortens longevity of a battery in the mobile station as well as reduces capacity and coverage of the system, thereby causing some discomfort for a mobile phone user.

As a solution to the above-mentioned drawbacks, a general-purpose repeater or an optical repeater has been installed between the base station and the mobile station so as to amplify and transmit the received signals.

However, in the case of using the general-purpose repeater or optical repeater to amplify the signals, there occurs a problem that the level of noise generated in the signals transmitted from the mobile station to the base station is also amplified.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide an apparatus for relaying only the signal transmitted from a specified base station (BS) to a receiving end of a mobile phone when a plurality of BS signals co-exist in a certain area, thereby preventing the reduction of efficiency in the use of system resources that may be caused by a pilot pollution phenomenon or an excessive handoff.

In accordance with the present invention, there is provided an apparatus for relaying a transmission signal, comprising:

- a receiving unit for receiving the transmission signal from a specified base station;
- a signal processing unit for processing the received signal; and
- a transmitting unit for transmitting the processed signal to a mobile station.

BRIEF DESCRIPTION OF THE INVENTION

The above and other objects and features of the present invention will become apparent from the following description of preferred embodiments given in conjunction with the accompanying drawings, in which:

Fig. 1 shows a situation where signals transmitted from a plurality of base stations co-exist;

Fig. 2 is a block diagram of an apparatus for relaying a transmission signal in accordance with the present invention; and

Fig. 3 illustrates the apparatus for relaying a transmission signal of the present invention, which is installed in an area where signals transmitted from a plurality of base stations co-exist.

DESCRIPTION OF SPECIFIC EMBODIMENTS

The preferred embodiments of the present invention will now be explained in detail with reference to the accompanying drawings.

5 Fig. 2 depicts a block diagram of an apparatus for relaying a transmission signal in a mobile telecommunications system in accordance with the present invention. The relaying apparatus comprises a receiving antenna (210) for receiving a signal transmitted from a specified base station, a signal processing unit for processing the received signal, which includes a first filtering unit (220), a first and a second amplifying unit (230 and 240), an
10 attenuator (250), a third amplifying unit (260), a second filtering unit (270), and a transmitting antenna (280) for transmitting the signal provided from the signal processing unit to a mobile station.

Hereinafter, an operation of the relaying apparatus having the above constitution will be described in detail.

15 The receiving antenna (210) has a high gain and a narrow horizontal beam width and is structured to receive the signal transmitted from the specified base station. That is, in a pilot pollution area or at a place where a soft blocking occurs to block calls, when the system is overloaded beyond its capacity, in order to maintain a certain level of communications quality, the receiving antenna (210) receives the signal transmitted from the specified base station,
20 wherein the specified base station is, for example, a base station having relatively smaller number of calls than other base stations neighboring to the one in which the soft blocking occurs, and provides the received signal to the first filtering unit (220), i.e., a band-pass filter.

The first filtering unit (220) filters only a desired signal band, i.e., a service frequency band from the transmission signal of the specified base station provided through the receiving
25 antenna (210), and then sends the filtered signal to the first amplifying unit (230).

The first amplifying unit (230) is a low noise amplifier (LNA), and primarily amplifies the signal within the service frequency band provided from the first filtering unit (220). After the first amplification, the signal is re-amplified at the second amplifying unit (240) and then provided to the attenuator (250).

30 Since the strength of the signal that arrives at the relaying apparatus from the base station varies depending on the environment of the service area, the attenuator (250) properly adjusts the gain of the amplified signal provided from the second amplifying unit (240) and provides the third amplifying unit (260) with the adjusted signal.

The third amplifying unit (260), as a high power amplifier (HPA), lastly amplifies the
35 gain-adjusted signal, and then provides the second filtering unit (270) with the finally amplified

signal.

The second filtering unit (270) filters off noises generated while the signal transmitted from the specified base station is processed. Then, the filtered signal is transmitted to the mobile station via the transmitting antenna (280).

5 Fig. 3 shows the relaying apparatus operating as described above, which is installed in a pilot pollution area or at a place where the soft blocking occurs.

As can be seen in Fig. 3, if signals transmitted from a plurality of base stations co-exist in a pilot pollution area (350), and thus the soft blocking occurs for a currently serving base station, a relaying apparatus (380) installed in that area selects a base station having
10 comparatively small number of calls among base stations neighboring to the currently serving base station as a specified base station. Then the relaying apparatus (380) transmits only the signal transmitted from the specified base station to a mobile station, so that a signal-to-noise ratio for the specified base station and the communications quality are improved.

To be specific, the relaying apparatus of the present invention monitors the occurrence
15 of the soft blocking in a downtown area or in a place where there exists a plurality of densely located base stations and signals transmitted therefrom. In case the soft blocking occurs, the relaying apparatus searches for the specified base station among the neighboring base stations.

The above process of finding the base station in which the soft blocking occurs and the specified base station having smallest number of calls is carried out by engineers of
20 telecommunications companies, and may be easily understood by those skilled in the art.

For example, in Fig. 3, there is illustrated a place where signals transmitted from a plurality of base stations co-exist, wherein a first base station (310) is found as the base station where the soft blocking occurs and a third base station (330) is selected to have the least calls among the neighboring base stations. When installed in such pilot pollution area, the relaying
25 apparatus (380) transmits only the signals transmitted from the specified base station, i.e., the third base station (330), to a mobile station (360). As a result, the calls are dispersed and the signal-to-noise-ratio for the specified base station is enhanced.

The relaying apparatus (380) also amplifies the strength of the signal transmitted from the specified base station and transmits the amplified signal to the mobile station (360).
30 Accordingly, a rate of system resources wasted by an excessive handoff can be reduced, so that the efficiency in using the system resources can be improved.

As described above, the transmission signal relaying apparatus (380) receives through the receiving antenna (210) only the signal transmitted from the third base station (330) having the least calls among the neighboring base stations; then extracts a signal within the service
35 frequency band from the received signal at the first filtering unit (220); performs the first and

second amplification at the first and the second amplifying unit (230 and 240); adjusts a gain of the amplified signal at the attenuator (250); lastly amplifies the gain-adjusted signal at the third amplifying unit (260); filters the lastly amplified signal at the second filtering unit (270); and finally transmits the filtered signal through the transmitting antenna (280) to the mobile station (360). By using the inventive relaying apparatus, both the signal-to-noise-ratio and the efficiency in using the system resources can be considerably improved.

While the present invention has been described with respect to the particular embodiments, it will be apparent to those skilled in the art that various changes and modifications may be made without departing from the spirit and scope of the invention as defined in the following claims.

CLAIMS

1. An apparatus, installed in an area where a pilot pollution phenomenon or soft blocking occurs, for relaying a signal transmitted from a specified base station to a mobile station,
5 comprising:
 - a receiving means for receiving the signal transmitted from the specified base station;
 - a signal processing means for processing the received signal; and
 - a transmitting means for transmitting the processed signal to the mobile station.
- 10 2. The apparatus of claim 1, wherein the specified base station is a base station having relatively smaller number of calls than the other neighboring base stations.
3. The apparatus of claim 1, wherein the signal processing means includes:
 - a first filtering means for filtering only a signal within a service frequency band of the
15 mobile phone from the received signal;
 - a first amplifying means for firstly amplifying the filtered signal;
 - a second amplifying means for secondly amplifying the firstly amplified signal;
 - an attenuating means for adjusting a gain of the secondly amplified signal so that the
mobile station can respond to a surrounding system environment;
 - 20 a third amplifying means for thirdly amplifying the gain-adjusted signal; and
 - a second filtering means for removing any noise from the thirdly amplified signal and
providing the noise-removed signal to the transmitting means.
4. The apparatus of claim 1, wherein the receiving means is a high gain antenna with a narrow
25 horizontal beam width.

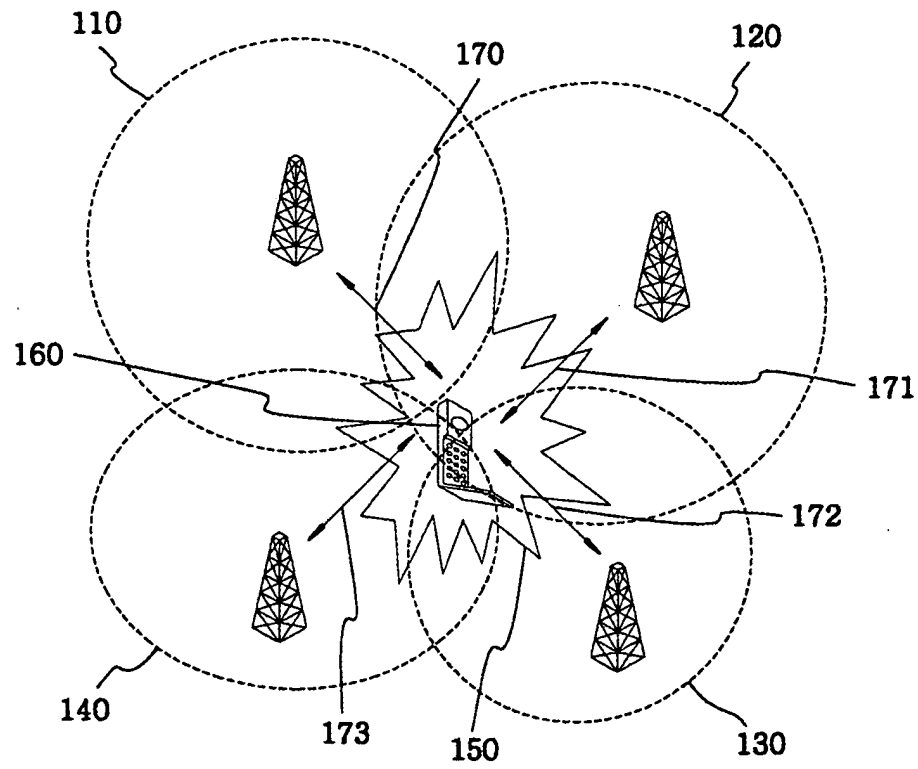
FIG. 1

FIG. 2

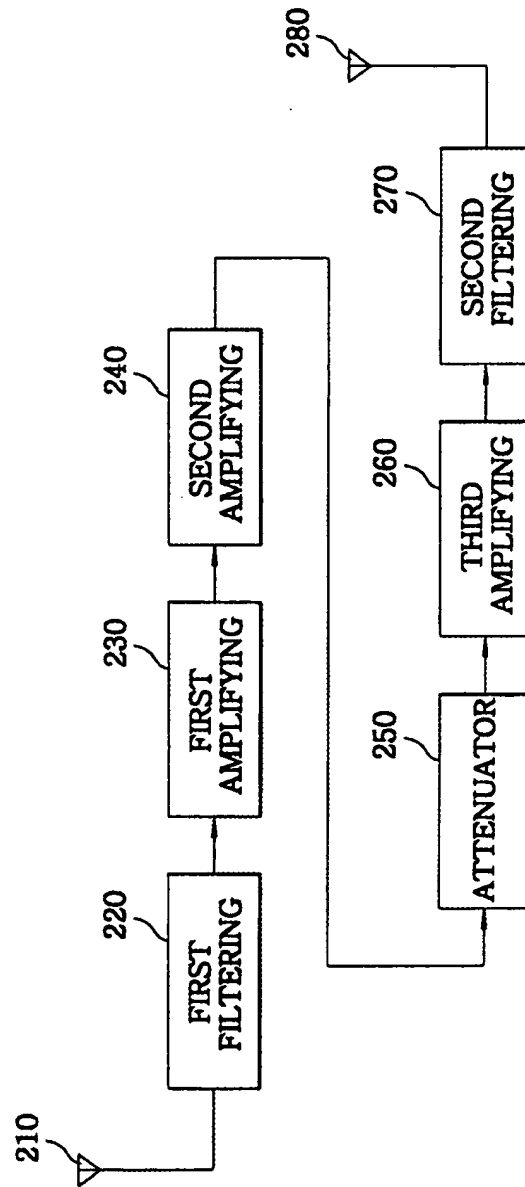
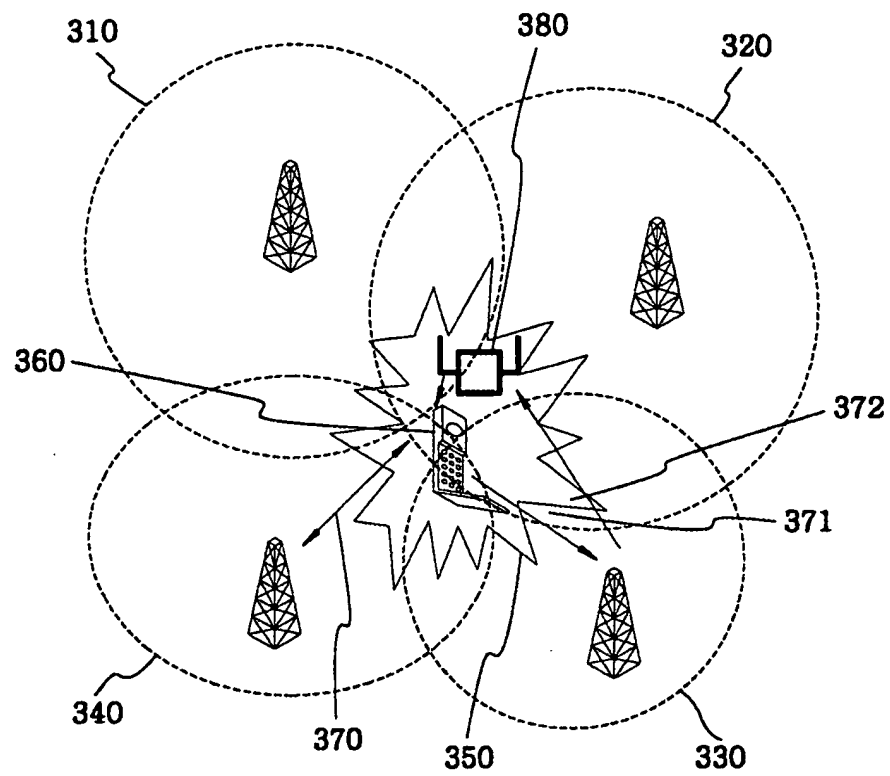


FIG. 3



INTERNATIONAL SEARCH REPORT

international application No.
PCT/KR00/01203

A. CLASSIFICATION OF SUBJECT MATTER**IPC7 H04B 1/59**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7 H04B 1/59

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Patents and applications for inventions since 1975

Korean Utility models and applications for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

FPD, PAJ, WPI(relay, amplifier, transmission, filter, station, handoff etc.)

PATROM

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 94-12911 (Samsung Electronics CORP.) 24 June 1994 See the abstract and Fig. 1	1
A	KR 96-27492 (Shinsegi telecommunication LTD.) 22 July 1996 See the claims and figures	1, 3
A	KR 99-7620 (Geosung Telecom LTD.) 25 January 1999 See the whole document	1, 2, 3
A	JP 11-27172 (Kokusai Electric CO.LTD.) 29 January 1999 See the claims and Fig. 1, 2	1, 2, 3
A	JP 8-8807 (Yagi Antenna CO LTD.) 12 January 1996 See the abstract and Fig. 1	1



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

31 JANUARY 2001 (31.01.2001)

Date of mailing of the international search report

31 JANUARY 2001 (31.01.2001)

Name and mailing address of the ISA/KR

Korean Industrial Property Office
Government Complex-Taejon, Dunsan-dong, So-ku, Taejon
Metropolitan City 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

JEONG, Hyun Su

Telephone No. 82-42-481-5949

